Organizing knowledge sharing in networks: The theory

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INTRODUCTION

Over the past decade, knowledge has become a central concept in the field of organization studies. Knowledge helps companies to outperform competitors (Winter, 1987). Knowledge can be compared with an accurate map. Having a map of the territory in which we want to travel gives us the coordinates of the places we want to go to and routes to get there. The map enables efficient travelling and avoids moving around by trial and error. Thus, knowledge about technology, customers, competitors and ways of organizing helps organizations to act efficiently and effectively.

It is widely claimed that the importance of knowledge in our economies and societies is increasing (Nonaka and Takeuchi, 1995; Drucker, 1993). More and more people in developed countries perform knowledge-intensive work and knowledge is becoming more and more quickly outdated. Technologies, for example, develop at an increasing speed. This means that organizations can differentiate themselves from competitors through their knowledge and capabilities. It is especially the tacit component of capabilities that makes them a source of competitive advantage (Winter, 1987; Berman et al., 2002). Tacit knowledge is the knowledge that we use unconsciously when we take conscious actions or apply explicit knowledge (Polanyi, 1958). Tacit knowledge is difficult to transfer, observe or sell. Capabilities built on tacit knowledge are therefore hard to replicate by others. Competitive advantage based on collective and tacit capabilities has a higher chance of being sustainable.

The recognition of the importance of knowledge and knowledge processes in organizations has spurred interest in knowledge management. Organizations stimulate internal knowledge sharing, so that knowledge can be re-used, re-combined and leveraged. Another challenge for organizations is to increase their stock of knowledge in order to increase efficiency, to develop new technologies or to adapt to the environment. This is the

more important when environments change, existing knowledge becomes outdated and competitive advantages erode.

Knowledge management can be oriented at exploitation and exploration (March, 1991). Exploration consists of 'the pursuit of new knowledge, of things that might come to be known'. It is the process leading to the development of new competences. Exploitation, in contrast, consists of 'the use and development of things already known' (Levinthal and March, 1993: 105). Exploitation helps to improve existing competences. Both exploration and exploitation involve learning, but the object of learning differs with respect to its familiarity. Because exploitation is concerned with learning how to do the same things better, feedback on exploitation is characterized by certainty, speed, proximity and clarity. Returns from exploration are systematically less certain, more remote in time and more distant from the locus of action. As a result, the knowledge management challenges associated with exploration and exploitation differ. While the emphasis on these basic processes may change over time, the viability of organizations depends on their capability to do both (March, 1991).

Organizations have often focused on developing new knowledge internally. However, more and more it is realized that the outside world is an important source of new knowledge as well (Chesbrough, 2003). By building strategic partnerships and networks the knowledge of different organizations can be combined in order to create complex innovations. In modular networks, organizations combine each other's knowledge base while keeping their own specializations. Yet, often organizations do more than just accessing knowledge of other parties. They actually share their knowledge and learn from each other. This chapter focuses on the facilitation of this knowledge-sharing process in interorganizational networks.

As Dyer and Nobeoka (2000) explain, knowledge sharing between companies in a network faces several potential problems. Sharing knowledge is often not in the interest of a company, which creates a potential motivation problem. Free-riding is another threat to knowledge sharing in interorganizational networks. A network partner may be inclined to reap the benefits from acquiring knowledge without intending to contribute to others. A third potential problem lies in the efficiency of knowledge sharing in a multi-partner network, as knowledge may be hard to find and transfer. Finally, it has been argued that boundaries between cultures, groups and languages may complicate learning processes between organizations. In order to overcome these barriers, management needs to support interorganizational knowledge sharing by appropriate means.

Dyer and Nobeoka (2000) also identified three mechanisms used to solve the knowledge-sharing dilemmas in Toyota's process innovation network. These mechanisms are network identity, network rules for

knowledge protection and value appropriation, and multiple knowledge-sharing processes. In the Toyota network, these mechanisms are effectuated by solutions like a supplier association, network-level consulting teams, voluntary learning teams, interfirm employee transfers and rules. Other authors have presented similar insights (e.g. Gittel and Weiss, 2004; Inkpen and Tsang, 2005) and have added other mechanisms, like trust (e.g. Liebeskind et al., 1996; Newell and Swan, 2000; Ring, 1999), commitment (e.g. Knight and Pye, 2005; Swan and Scarbrough, 2005), absorptive capacity (e.g. Brown and Duguid, 2001; Powell et al., 1996) and relationships (e.g., Lorenzoni and Lipparini, 1999; Hardy et al., 2003).

This chapter seeks to integrate existing research on the management of knowledge in networks in a comprehensive model, by means of an extensive literature review. We follow Denyer and Tranfield's (2005) design-oriented approach, to synthesize both theoretical research and more managerial studies. In addition to exploring management instruments as means to facilitate knowledge sharing in networks, we also focus on contextual factors influencing their effectiveness. These contextual factors have not been systematically investigated (Brown and Duguid, 2001). In this literature review, the network and knowledge characteristics as defined in Chapter 1 are taken into account as contextual factors.

RESEARCH MODEL AND APPROACH

In this review we adopt a 'design-oriented perspective'. This emerging perspective aims to reconnect organization theory to the practice of organization design (van Aken, 2004; Romme, 2003; Romme and Endenburg, 2006). The aim of design-oriented research is to provide practitioners with validated prescriptive knowledge, to be used for the design of solutions for managerial and organizational problems.

Prescriptive design knowledge is codified in design rules (also called technological rules). These rules are comprised of four components: a context, a solution concept, a mechanism triggered by the solution concept and an intended outcome (Denyer and Tranfield, 2005). The general layout of such a rule is: to achieve outcome A, in context C, use solution concept B (van Aken, 2004; Romme and Endenburg, 2006). Solution concepts are the core of such a design rule. Solution concepts are generic principles or systems which managers can implement or realize to influence organizational processes (Denyer and Tranfield, 2005). They form the practical or instrumental basis for design work in organizations (Romme and Endenburg, 2006).

In our guiding framework, presented in Chapter 1, all elements of the design-oriented approach could be recognized. In the end, interorganizational collaboration is a means to increase the innovative capacities of organizations. We focus particularly on knowledge sharing in networks, which is an important enabler of the innovation process. Knowledge sharing is taken as the intended outcome of solution concepts and mechanisms. The context factors that are taken into consideration are the nature of knowledge and type of network.

Paper Collection

The publications incorporated in this literature review were collected in a semi-structured manner, through a combination of keyword search and the snowball method. The ABI/Inform database was searched using combinations of the following keywords: 'knowledge network', 'innovation network', 'knowledge', 'interfirm', 'interorganizational', 'learning', 'alliance', 'network', 'partners' and 'collaboration'. Furthermore, the articles that were identified were scanned for references to other relevant articles. In total, 45 publications were identified and included in this review.

Analysis

Following the design-oriented approach to literature reviews as advocated by Denyer and Tranfield (2005), we analysed the collected literature for solution concepts and contextual elements which explain the outcome: knowledge sharing in an interorganizational network. Solution concepts were defined above as the means that managers have to influence organizational processes. So, the 'mechanisms', 'tools' and so on that managers can employ to influence organizational processes, are interpreted as solution concepts. We also identified 'mechanisms', 'instruments' and so on that are less tangible and are sometimes the consequence of solution concepts, like 'trust' and 'network identity'. In our literature review, we distinguished these from the more tangible, first-order solution concepts. By distinguishing between these two categories of solution concepts we were to some extent able to deal with the problem that examined solutions act on different abstraction levels and at different places in the causal chain. For example, 'trust' and 'selection systems' may both enable collaboration, but they are quite distinct types of concepts, as Grandori and Soda (1995) noted.

The review was complicated by the fact that a lot of different terms are used in the literature. In a way comparable to grounded theory building, we developed a standard set of codes, and coded articles for the different

elements of the framework. We captured part of this coding exercise in the Appendix, which increases the traceability of the findings presented.

TANGIBLE SOLUTION CONCEPTS FOSTERING KNOWLEDGE SHARING

In this section, we discuss eight solution concepts that were identified within the literature. In this discussion, we note when these solution concepts are related to less tangible solution concepts discussed in the next section. In the Appendix, we present an overview of the literature that supports the findings presented below.

Personnel Transfer

The first solution concept for stimulating knowledge sharing is the transfer of personnel among organizations. These transfers may consist of relatively short stays of individuals at partner organizations, but also of more permanent employment at the partner's organization. Transferring personnel from one partner to another may stimulate knowledge sharing in two ways. First, personnel transfer creates opportunities for knowledge sharing. By transferring individuals from one part of the network to another, particular technological knowledge can be dispersed. People are also able to build new relationships, therewith increasing the efficiency of knowledge transfer (Inkpen and Tsang, 2005). Furthermore, personnel transfer generates a greater dispersion of knowledge about available competences, systems and technology (Dyer and Nobeoka, 2000), thus improving the efficiency of searching knowledge (Inkpen and Dinur, 1998). Finally, employees learn to understand multiple perspectives, thus improving the sharing of tacit knowledge.

Personnel transfer also stimulates knowledge sharing by fostering the creation of network identity. By transferring personnel, the unit of analysis for job rotation is not the individual firm, but the network (Dyer and Nobeoka, 2000). People who are transferred to other companies come to see members of other organizations as colleagues as well and their colleagues within their home organization will also be tempted to do so.

Printed and Electronic Media

Sharing documents and using information systems are common ways to exchange information and are applicable within interorganizational

networks. Because these channels usually provide little context, it is hard to share knowledge that is difficult to codify. But using information systems and documents for the transfer of codified knowledge improves the efficiency. Regarding information systems, empirical research among 22 supply chain networks shows that integrative mechanisms (EDI, integrated business systems, IT integration) are an important means to support learning (Spekman et al., 2002; Gittel and Weiss, 2004). On the other hand, a lack of information systems can decrease the efficiency of knowledge sharing (Newell and Swan, 2000).

Knowledge Brokers

Efficient knowledge sharing in a network can be enhanced by knowledge brokers who are able to span the boundaries of different organizations, groups or practices and are able to integrate and combine the knowledge of different partners (Grant and Baden-Fuller, 2004). Three types of brokers can be distinguished: network platforms, (consultancy) groups, and individuals. First, Soekijad and Andriessen (2003) describe network platforms that fulfil the brokering role. These network platforms bring different partners in the network into contact with each other and are sometimes able to bridge boundaries. Second, consulting groups could bridge the boundaries between the network partners, by having access to different communities, transferring knowledge from one social community to the other and translating the knowledge if necessary (Swan and Scarbrough, 2005). Third, individuals can fulfil the brokering role. For example, certain companies have appointed cultural ambassadors: people who act as interpreter between individuals from various industries who cooperate in the network (Duysters et al., 1999).

Direct Communications

Direct communications in a network context come in different forms: (co-located) team working, social events, conferences, site visits and frequent discussion sessions. Especially co-location of teams is a means that enables deep interactions and increases the efficiency of knowledge sharing because of the opportunity for frequent communication and interaction.

Frequent direct communication in an interorganizational network enables and improves knowledge sharing in three ways: by providing knowledge-sharing opportunities, by creating network identity and by constituting trust. First, direct communications are an important means of dispersing knowledge because they provide knowledge-sharing

opportunities. When people are meeting each other (face to face) they are able to communicate and thus to share knowledge (e.g. Dyer and Nobeoka, 2000; Spekman et al., 2002). Second, network identity is created by network-level meetings. Frequent face-to-face meetings create a social community (Dyer and Nobeoka, 2000; Orlikowski, 2002) and help to develop relationships (Hansen, 1999; Soekijad and Andriessen, 2003). These processes create a shared purpose among partners and help them to believe that they are part of a larger collective. Third, frequent direct communications can create trust. Trust is process-based in the sense that firms test each other's integrity in small exchanges and then decide to move to more open-ended deals with substantial risk (Inkpen and Tsang, 2005). This process of testing each other also happens at the individual level, thus enabling behaviour-based trust (Newell and Swan, 2000; Orlikowski, 2002).

Goal Alignment

Goal alignment is the process by which partners bring into line their perspectives, by taking decisions, thus generating shared goals, constituting commitment and trust. If decision-making is balanced, partners tend to be more committed towards the goal of cooperation (Muthusamy and White, 2005). Having unequal influence on decisions and agreements may result in the development of a sense of injustice and this could end in loss of commitment (Larsson et al., 1998; Muthusamy and White, 2005). Regarding trust, Ring (1999) argues that joint decision-making develops trust through negotiation and transaction between individuals and organizations. In the case of the university network that Newell and Swan (2000) examined, however, it is demonstrated that formal power and control mechanisms impede the development of trust if not accompanied by informal mechanisms like communication and relationships.

A second aspect of goal alignment is the establishment of shared goals and norms. Shared goals and norms are a source of trust as they define what appropriate and what inappropriate behaviour is. This gives some assurance to members of the network that if they share knowledge with somebody, someone else will be willing to do the same for them in the future (Reagans and McEvily, 2003). Furthermore, network partners' shared perceptions about their interaction stimulate absorptive capacity, which is the ability to recognize, assimilate and apply new knowledge by means of prior related knowledge (Cohen and Levinthal, 1990). Goal alignment creates a bonding mechanism that helps to integrate knowledge through the mutual understanding and exchange of ideas and resources (Inkpen and Tsang, 2005; Knight and Pye, 2004, 2005).

Interpersonal Relationships

Another important way to increase knowledge sharing is the development of interpersonal ties between members of different network organizations. Interpersonal relationships enable and improve knowledge sharing through a number of effects: by providing opportunities for knowledge sharing, by engendering trust and commitment, and by generating absorptive capacity. First, relationships provide a channel for knowledge sharing. Knowledge is not a resource that can be transferred as a commodity from one organization to another. It needs social and personal interaction, especially for the transfer of tacit knowledge and the creation of new knowledge (Berends, 2003; Hamel, 1991; Hardy et al., 2003; Kale et al., 2000; Powell et al., 1996; Reagans and McEvily, 2003). By having deep interpersonal contact both codified and non-codified knowledge can be shared. Second, relationships enhance trust. People who interact with each other frequently form strong relationships or even friendships. Both interpersonal and interfirm relationships form the basis for the development of trust. Based on the behaviour of firms and individuals, partners develop a sense of their trustworthiness and reputation (Inkpen and Tsang, 2005; Muthusamy and White, 2005; Newell and Swan, 2000; Ring, 1999; Ring and van de Ven, 1994; Soekijad and Andriessen, 2003). The third effect of relationships is commitment. Through ongoing interactions and exchanges in relationships, negotiation of purposes and goals takes place, thus developing commitment that exists in psychological contracts (Ring and van de Ven, 1994). This relationship-based commitment motivates knowledge sharing, thus enabling the transfer of tacit knowledge (Reagans and McEvily, 2003). Finally, absorptive capacity may be developed by relationships and communities. These communities mediate between individuals in large formal and informal structures. Within a community meanings can be created and shared, developing common understanding and associated knowledge (Brown and Duguid, 2001; Swan and Scarbrough, 2005).

Rules and Agreements

Agreements and rules at dyadic and network levels create trust and commitment. When network members are also each other's competitors, trust may be difficult to establish. Clear rules can reduce distrust between network partners (Inkpen and Tsang, 2005; Ring, 1999). Such agreements need to be unambiguous and beneficial for both parties in order to engender trust (Newell and Swan, 2000). Too many regulations, however, can be a symptom of mistrust (Soekijad and Andriessen, 2003). Furthermore, by making agreements, contracts and rules, the mutual benefits and efforts of

the relationships are defined, thus providing a basis for commitment to deliver according to the details of the contract (Newell and Swan, 2000; Ring, 1999, Spekman et al., 2002; Steensma and Corley, 2000). These formalized agreements are not the commitment itself, but these agreements form the basis for the development of commitment, constituted by demonstrating the formal reciprocal attitude (Muthusamy and White, 2005). One special type of rules has to be mentioned here, namely rewarding rules. Several authors have found evidence that rewarding rules can help to create commitment (Dyer and Nobeoka, 2000; Larsson et al., 1998; Mody, 1993; Orlikowski, 2002; Spekman et al., 2002).

Partner Selection

In the formation of a network (or reformation of a network) careful partner selection can yield trust and stimulates absorptive capacity. Trust can be constituted in two ways: first, partners can be chosen that are trustworthy (Muthusamy and White, 2005; Powell et al., 1996; Soekijad and Andriessen, 2003). Second, if a partner is selected that is comparable as a peer, mutual respect with regard to the competency of the person or organization can be established, thus enabling competence-based trust (Newell and Swan, 2000; Soekijad and Andriessen, 2003). Furthermore, the selection of partners who are engaged in comparable practices stimulates mutual absorptive capacity. A shared practice provides a work context within which a shared perspective can be constructed. Within such a context, complementary knowledge can be shared and new knowledge can be created (Brown and Duguid, 2001). Similar organizational routines (complex patterns of coordination), similar professions, common models, tools and methodology enable organizations' members to work closely together, and to cross organizational boundaries (Carlile, 2004; Grant and Baden-Fuller, 2004; Inkpen and Dinur, 1998; Knight and Pye, 2004; Podolny and Page, 1998; Orlikowski, 2002).

LESS TANGIBLE SOLUTION CONCEPTS FOSTERING KNOWLEDGE SHARING

We identified three less tangible solution concepts in the literature: absorptive capacity, trust and commitment, and network identity. Each of these solution concepts in some way enables knowledge sharing in a network. In the foregoing section, we already noted that these solution concepts are sometimes constituted by other solution concepts, or have a mediating effect for other solution concepts. We will discuss them below.

Absorptive Capacity

To share knowledge among partners, these partners should be able to absorb it. Absorptive capacity is a prerequisite for effective knowledge sharing in interorganizational networks. This concept is based on the idea that people usually learn new ideas by associating these ideas with what they already know. Therefore, people may more easily absorb knowledge from areas in which they already have some knowledge. An implication is that the ability to absorb knowledge from a network partner is contingent on the stock of related knowledge (Cohen and Levinthal, 1990; Podolny and Page, 1998). Thus, partners require both common knowledge to be able to absorb knowledge and complementary knowledge to provide learning opportunities (Powell et al., 1996).

Trust and Commitment

Trust results in stability of relationships and confidence in the interaction of network partners. Confidence and stability are important conditions for ongoing interactions and deep exchanges (Newell and Swan, 2000; Podolny and Page, 1998; Ring, 1999). Trust is a substitute for formal control mechanisms as it constitutes implicit norms and sanctions (Newell and Swan, 2000; Podolny and Page, 1998), and makes firms more willing to invest resources in learning and knowledge sharing. In a situation with sufficient trust, partners are not afraid of knowledge spillovers and the firm's decision-makers and employees are less likely to protect themselves against opportunistic behaviour by their partners (Inkpen and Tsang, 2005; Newell and Swan, 2000; Swan and Scarbrough, 2005).

Commitment is 'the form of a moral obligation as opposed to a concern for individual gratification' (Muthusamy and White, 2005: 419). It is a necessary mechanism for knowledge sharing: it ensures the stability of the relationship and creates the conditions for network members to be loyal enough to share knowledge (Hardy et al., 2003; Newell and Swan, 2000). Although it seems clear that commitment is an enabler for knowledge sharing in a network, commitment itself can hardly be designed. Commitment is a result of fragmented and incidentally taken decisions and choices (Knight and Pye, 2005).

Network Identity

Having a shared identity means that individuals share a sense of purpose and belonging with other members of a collective (Kogut, 2000). Such a shared identity can also develop within a network of organizations.

Knowledge is most effectively shared by individuals who identify with a larger collective and consider other network members to be 'one of us'. When people feel themselves to be part of a larger collective, they become motivated to contribute to that collective and to share even tacit or core knowledge (Dyer and Nobeoka, 2000; Kogut, 2000). Furthermore, Dyer and Nobeoka (2000) argue that a shared identity establishes explicit and tacit rules of coordination. People sharing a network identity know what to expect from each other.

CONTINGENCY FACTORS

It is unlikely that solutions are equally effective across a range of different situations. In this chapter we discuss two groups of contingency factors that may affect the effectiveness of the identified solution concepts. First, we explore the moderating effect of the type of knowledge that is being shared in a network. Second, we explore the impact of the type of network.

Tacit and Explicit Knowledge

A basic distinction is often made between tacit and explicit knowledge. Tacit knowledge refers to knowledge that we use without being fully aware of it (Polanyi, 1958). It enables us to do things without being able to tell exactly how. Tacit knowledge is usually difficult to codify, and resides, for instance, in routines, skills and competences (Nonaka, 1994). Nonaka and Takeuchi (1995) distinguished two dimensions of tacit knowledge: a technical one and a cognitive one. The first embodies know-how: the skills and behaviour of a person. The latter consists of mental models: ideas and values. Explicit knowledge is the type of knowledge that can be expressed in codified symbols, language or otherwise. For example, a manual contains explicit knowledge. Brown and Duguid (2001) argue that to understand explicit knowledge, tacit knowledge is necessary. Because of the importance of tacit knowledge, we prefer the term 'knowledge sharing' over 'knowledge transfer'. The latter presupposes that knowledge is like a package or a concrete thing (Soekijad, 2005: 18). This may be applicable to explicit knowledge or information, but definitely not to tacit knowledge. Knowledge sharing occurs through multiple actions and processes, like co-working, talking, sharing documents and so on.

Research within organizations has found that the codifiability of knowledge influences the effectiveness of solution concepts (Hansen, 1999). Two aspects influence the fit of solution concepts with tacit or explicit knowledge: the formality of the solution concept and richness of

Table 3.1 Tangible solution concepts for codified and tacit knowledge

Knowledge type	Solution concept
Mainly *codified knowledge*	Rules and agreements Goal alignment Printed and electronic media
Both *codified* and *tacit knowledge*	Knowledge brokers
Mainly *tacit knowledge* sharing	Personnel transfer Direct communications Interpersonal relationships Partner selection

the communication media. Makhija and Ganesh (1997) argue that formal mechanisms enhance predictability of events and standardization of processes. Using these mechanisms for knowledge sharing assumes that the knowledge is separable from the individual who possesses it, which is not applicable to tacit knowledge. Formal mechanisms are more feasible for sharing codified knowledge and less for sharing non-codifiable knowledge. Because tacit knowledge is highly personal it cannot easily be communicated to a different person or context (Nonaka, 1994). The personal component requires human (face-to-face) interaction for sharing tacit knowledge. Solution concepts that allow for richer communication are more suited to sharing tacit knowledge (Nonaka, 1994). Solution concepts that only support low-context and impersonal interaction are less suited to sharing tacit knowledge.

Taking these aspects into account, the appropriateness of the solution concepts for sharing codified and non-codified knowledge can be discussed (see Table 3.1). In this discussion, we focus on the tangible concepts because they are more manageable. First, reports and information systems are mainly feasible for sharing codified knowledge (but to interpret this knowledge, common (tacit) knowledge is necessary, according to Brown and Duguid, 2001). Also rules and agreements and goal alignment are more likely to enhance the sharing of codified knowledge than of tacit knowledge, because of the high formality of these solution concepts. Second, knowledge brokers could, to some extent, enable the sharing of both types of knowledge. They have the explicit role to bridge boundaries and to translate the languages of disjoint practices. Third, the solutions that involve rich personal interaction enable tacit knowledge sharing. The deeper the interaction, like interpersonal relations or co-working in a co-located team, the better tacit knowledge can be shared (Hansen, 1999; Reagans and McEvily, 2003). Thus, personnel transfer, direct communication and

interpersonal relationships are effective at sharing tacit knowledge. Also partner selection may enable the sharing of tacit knowledge, although this may seem to be a formal mechanism. But, by choosing a trustworthy partner with a shared practice, common knowledge and absorptive capacity can be constituted, thus enabling sharing tacit knowledge.

Coreness of Knowledge

The coreness of knowledge refers to the importance of knowledge for the firm's core competences. Core knowledge is that particular kind of knowledge that creates the core competences of a firm (Blaauw, 2005). These core competences form the basis for the sustainable competitive advantage of a firm (Prahalad and Hamel, 1990). Two consistent themes appear in the literature about competencies: the source is always internal to the firm and a competency is produced by the use of the firm's internal skills and resources (Reed and DeFillippi, 1990). When firms are cooperating, they share their non-core knowledge rather than their core knowledge. Obviously they prefer to maintain their competitive advantage. Especially when the cooperating firms are competitors, there is likely to be a tendency to protect core knowledge. Thus, the motivation dilemma will be particularly strong if core knowledge is involved. Solution concepts that are able to deal with this dilemma are very important if core knowledge has to be shared.

The first solution concept that might overcome the reluctance to share core knowledge is trust (Newell and Swan, 2000). Soekijad and Andriessen (2003) assessed conditions and mechanisms for knowledge sharing in co-opetitive partnerships. They conclude that the creation of trust lowers the tendency to protect knowledge, as it involves the conviction that others will not abuse openness. According to Kale et al. (2000), mechanisms that constitute mutual trust, friendship and respect reduce the protection of core knowledge. Following this reasoning, interpersonal relationships and other solution concepts that effectuate trust (knowledge brokers, rules and agreements, goal alignment, partner selection) are able to reduce knowledge protection and thus enable the flow of core knowledge. Relationships establish their own norms and these norms are even more stable than contractual norms (Liebeskind et al., 1996). Agreements can also express commitment at the managerial level and can include property rules that provide clarity about the status of knowledge and the expected sharing behaviour (Dyer and Nobeoka, 2000). The expected sharing behaviour can furthermore be improved by rewarding rules for knowledge sharing (Dyer and Nobeoka, 2000; Mody, 1993; Orlikowski, 2002; Spekman et al., 2002).

Another solution concept that enables sharing core knowledge is network identity. When partners and employees identify with the larger collective,

they become motivated to share even their core knowledge (Dyer and Nobeoka, 2000). Thus, it can be expected that the solution concepts for network identity, personnel transfer and direct communications enable the sharing of core knowledge.

Network Centrality

What is the effect of centrality or decentrality on the feasibility of the identified solution concepts? Powell et al. (1996) examined the effect of centrality on learning in interorganizational networks in the bioindustry in the US. They found that a firm's centrality in a network enhances knowledge sharing and learning because it intensifies the firm's commitment and facilitates common understanding (because of frequent interactions) and shared principles of cooperation. In a more centralized network, knowledge-sharing mechanisms can be more formally implemented, as has been shown in a number of case studies (Dyer and Nobeoka, 2000; Knight and Pye, 2004, 2005; Soekijad and Andriessen, 2003; Swan and Scarbrough, 2005; van Baalen et al., 2005). However, in a decentralized network, agreements and rules can be made in dyadic relationships within the network, but seldom at the network level. In decentralized networks, power and commitment have less to do with authority because there is no single firm that is able to exert power over the other partners. Power in such a network setting is more reputational and relational; it has to do with expertise and social bonds and close relationships (Achrol, 1997). Therefore, to enable knowledge sharing in decentralized networks, informal mechanisms are crucial.

Single versus Multiple Innovations

In the literature reviewed, no difference is found between networks that aim to perform one single innovation and networks that aim for continuous collaboration in order to establish multiple innovations. One reason may be that most studies concentrate on long-term innovations, or because longitudinal studies are scarce and therefore the effect of time is not examined. On the one hand, if cooperation lasts longer, the need to solve dilemmas becomes stronger because these problems are likely to become more severe (Das and Teng, 2002). On the other hand, a number of authors recommend that a long-term orientation in interorganizational collaboration is beneficial because it reduces opportunistic behaviour and long-lasting relationships can be built (Lorenzoni and Lipparini, 1999; Walker et al., 1997; Ring and van de Ven, 1994). When network partners know that they are going to cooperate for a longer period, opportunistic behaviour (like

free-riding and knowledge protection) is reduced. Ongoing network collaboration enables the building of learning mechanisms like strong ties and social norms (Dyer and Nobeoka, 2000). Because trust is partly built on ongoing interactions, a continuous collaboration seems to be a context where this mechanism can flourish more than in a one-off collaboration.

DISCUSSION AND CONCLUSIONS

In this literature review, we took a design-oriented approach to reviewing the literature on knowledge sharing in networks. This approach was helpful to integrate findings and to articulate insights into the moderating effects of knowledge and network type.

This review has also exposed some limitations in the existing literature. First, most of the research on managing knowledge sharing in networks takes a positive approach. The positive effects of solution concepts are extensively examined, but the limitations of these concepts are not investigated. For example, the positive effects of interpersonal relationships are frequently established, but potential negative effects, like conflicts and groupthink, are scarcely examined. If performance is below expectations, this is often blamed on inaccurate implementation and not on the inappropriateness of a solution concept itself. Furthermore, the costs of implementing particular solutions are seldom taken into account. A second weakness in the literature is that there is a tendency towards 'more is better' with regard to knowledge sharing in networks. Knowledge sharing and cooperation are usually assumed to be beneficial (as we have implicitly assumed in this chapter). In the literature about knowledge sharing in interorganizational networks, the dark sides and the risk factors of these cooperations have received less attention. In this regard, the literature about supplier involvement in innovation processes can be a source of complementary insight. This literature has investigated risk factors such as the probability that a supplier capability will fail to meet a customer's requirements (Huang et al., 2003). The third weakness is the lack of studies that take contextual factors into account. The moderating effects of environmental factors, knowledge types and network characteristics are hardly examined.

This review itself has some limitations as well. Due to its broad scope, the solution concepts could not be explored in great depth. A complicating factor was that the case studies presented in the literature often do not describe managerial interventions in full detail. Again, the literature on supplier involvement may be a source of additional insight. For example, Wynstra et al. (2003) proposed a framework for supplier interface man-

agement in new product development which incorporates many of the elements presented in this chapter. This framework covers activities across four management levels of interfirm cooperation and knowledge sharing. The solution concepts are described in more detail and depth and become more practical to implement in a real business situation. The case studies presented in the other chapters also serve to provide further detail with regard to the different solution concepts presented in this chapter.

SUMMARY

For many companies, managing knowledge sharing in interorganizational networks is important for their competitive advantage. Knowledge management has to deal with four potential problems: motivation, free-riding, efficiency and boundaries. We found several solution concepts that can be applied to prevent and reduce these problems. A number of tangible, manageable mechanisms are found in the literature: personnel transfer, printed and electronic media, knowledge brokers, direct communication, goal alignment, interpersonal relationships, rules and agreements, and partner selection. Besides this, there are other, less tangible means: absorptive capacity, trust and commitment, and network identity. The effect of these solution concepts depends on contextual elements, including the type of knowledge, the coreness of knowledge, and network and innovation characteristics.

REFERENCES

Achrol, R.S. (1997), 'Changes in the theory of interorganizational relations in marketing: toward a network paradigm', *Journal of the Academy of Marketing Science*, **25** (1), 56–71.

Ahuja, G. (2000), 'Collaboration networks, structural holes, and innovation: a longitudinal study', *Administrative Science Quarterly*, **45** (3), 425–54.

Berends, H. (2003), *Knowledge Sharing in Industrial Research*, Dissertation, Eindhoven: Eindhoven University Press.

Berman, S.L., J. Down and C.W.L. Hill (2002), 'Tacit knowledge as a source of competitive advantage in the National Basketball Association', *Academy of Management Journal*, **45** (1), 13–31.

Blaauw, G. (2005), *Identificatie van Cruciale Kennis*, Dissertation, Ridderkerk: RU Groningen.

Brown, J.S. and P. Duguid (2001), 'Knowledge and organization: a social-practice perspective', *Organization Science*, **12** (2), 198–213.

Carlile, P.R. (2004), 'Transferring, translating, and transforming: an integrative framework for managing knowledge across boundaries', *Organization Science*, **15** (5), 555–68.

Chesbrough, H.W. (2003), *Open Innovation*, Boston, MA: Harvard Business School Press.
Cohen, W.M. and D.A. Levinthal (1990), 'Absorptive capacity: a new perspective on learning and innovation', *Administrative Science Quarterly*, **35** (1), 128–52.
Daghfous, A. (2004), 'Organizational learning, knowledge and technology transfer: a case study', *The Learning Organization*, **11** (1), 67–83.
Das, T.K. and B.-S. Teng (2002), 'Alliance constellations: a social exchange perspective', *Academy of Management Review*, **27** (3), 445–56.
Denyer, D. and D. Tranfield (2005), 'Developing technological rules from a synthesis of the science base', Paper presented at Euram conference 2005.
Drucker, P.F. (1993), *Post-capitalist Society*, Oxford: Butterworth-Heinemann.
Dubois, A. and H. Håkansson (1999), 'Relationships as activity links', in M. Ebers (ed.), *The Formation of Inter-organizational Networks*, Oxford: Oxford University Press, pp. 43–65.
Duysters, G., A.P. de Man and L. Wildeman (1999), 'A network approach to alliance management', *European Management Journal*, **17** (2), 182–7.
Dyer, J.H. and K. Nobeoka (2000), 'Creating and managing a high-performance knowledge-sharing network: the Toyota case', *Strategic Management Journal*, **21**, 345–67.
Ebers, M. (1999), 'Explaining inter-organizational network formation', in M. Ebers (ed.), *The Formation of Inter-organizational Networks*, Oxford: Oxford University Press, pp. 3–40.
Gittel, J.H. and L. Weiss (2004), 'Coordination networks within and across organizations: a multi-level framework', *Journal of Management Studies*, **41** (1), 127–53.
Grandori, A. and G. Soda (1995), 'Inter-firm networks: antecedents, mechanisms and forms', *Organization Studies*, **16** (2), 183–214.
Grant, R.M. and C. Baden-Fuller (2004), 'A knowledge accessing theory of strategic alliances', *Journal of Management Studies*, **41** (1), 61–84.
Hamel, G. (1991), 'Learning in international alliances', *Strategic Management Journal*, **12**, 83–103.
Hansen, M.T. (1999), 'The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits', *Administrative Science Quarterly*, **44** (1), 82–111.
Hardy, C., N. Phillips and T.B. Lawrence (2003), 'Resources, knowledge and influence: the organizational effects of interorganizational collaboration', *Journal of Management Studies*, **40** (2), 321–47.
Huang, G.Q., K.L. Mak and P.K. Humphreys (2003), 'A new model of the customer-supplier partnership in new product development', *Journal of Materials Processing Technology*, **138** (1), 301–5.
Inkpen, A.C. (1998), 'Learning and knowledge acquisition through international strategic alliances', *Academy of Management Executive*, **12** (4), 69–80.
Inkpen, A.C. (2000), 'Learning through joint ventures: a framework of knowledge acquisition', *Journal of Management Studies*, **37** (7), 1019–43.
Inkpen, A.C. and A. Dinur (1998), 'Knowledge management processes and international joint ventures', *Organization Science*, **9** (4), 454–68.
Inkpen, A.C. and E.W.K. Tsang (2005), 'Social capital, networks, and knowledge transfer', *Academy of Management Review*, **30** (1), 145–65.
Jones, C., W.S. Hesterly and S.P. Borgatti (1997), 'A general theory of network governance: exchange conditions and social mechanisms', *Academy of Management Review*, **22** (4), 911–45.

Kale, P., H. Singh and H. Perlmutter (2000), 'Learning and protection of proprietary assets in strategic alliances: building relational capital', *Strategic Management Journal*, **21** (3), 217–37.
Knight, L. and A. Pye (2004), 'Exploring the relationships between network change and network learning', *Management Learning*, **35** (4), 473–90.
Knight, L. and A. Pye (2005), 'Network learning: an empirically derived model of learning by groups of organizations', *Human Relations*, **58** (3), 369–92.
Kogut, B. (2000), 'The network as knowledge: generative rules and the emergence of structure', *Strategic Management Journal*, **21**, 405–25.
Lane, P.J. and M. Lubatkin (1998), 'Relative absorptive capacity and interorganizational learning', *Strategic Management Journal*, **19** (5), 461–77.
Larsson, R., L. Bengtsson, K. Henriksson and J. Sparks (1998), 'The interorganizational learning dilemma: collective knowledge development in strategic alliances', *Organization Science*, **9** (3), 285–305.
Levinthal, D. and J. March (1993), 'The myopia of learning', *Strategic Management Journal*, **14** (Winter Special Issue), 95–112.
Liebeskind, J.P., A.L. Oliver, L. Zucker and M. Brewer (1996), 'Social networks, learning, and flexibility: sourcing scientific knowledge in new biotechnology firms', *Organization Science*, **7** (4), 428–43.
Lorenzoni, G. and A. Lipparini (1999), 'The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study', *Strategic Management Journal*, **20** (4), 317–38.
Makhija, M.V. and U. Ganesh (1997), 'The relationship between control and partner learning in learning-related joint ventures', *Organization Science*, **8** (5), 508–27.
March, J.G. (1991), 'Exploration and exploitation in organizational learning', *Organization Science*, **2** (1), 71–87.
Mody, A. (1993), 'Learning through alliances', *Journal of Economic Behavior and Organization*, **20**, 151–70.
Mowery, D.C., J.E. Oxley and B.S. Silverman (1996), 'Strategic alliances and interfirm knowledge transfer', *Strategic Management Journal*, **17**, 77–91.
Muthusamy, S.K. and M.A. White (2005), 'Learning and knowledge transfer in strategic alliances: a social exchange view', *Organization Studies*, **26** (3), 415–41.
Newell, S. and J. Swan (2000), 'Trust and inter-organizational networking', *Human Relations*, **53** (10), 1287–328.
Nonaka, I. (1994), 'A dynamic theory of organizational knowledge creation', *Organization Science*, **5** (1), 14–37.
Nonaka, I. and H. Takeuchi (1995), *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*, New York: Oxford University Press.
Orlikowski, W.J. (2002), 'Knowing in practice: enacting a collective capability in distributed organizing', *Organization Science*, **13** (3), 249–73.
Peña, I. (2002), 'Knowledge networks as part of an integrated knowledge management approach', *Journal of Knowledge Management*, **6** (5), 469–78.
Podolny, J.M. and K.L. Page (1998), 'Network forms of organization', *Annual Review of Sociology*, **24**, 57–76.
Polanyi, M. (1958), *Personal Knowledge*, London: Routledge and Kegan Paul.
Powell, W.W., K.W. Koput and L. Smith-Doerr (1996), 'Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology', *Administrative Science Quarterly*, **41** (1), 116–45.

Prahalad, C.K. and G. Hamel (1990), 'The core competence of the corporation', *Harvard Business Review*, **68** (3), 79–92.
Reagans, R. and B. McEvily (2003), 'Network structure and knowledge transfer: the effects of cohesion and range', *Administrative Science Quarterly*, **48**, 240–67.
Reed, R. and R.J. DeFillippi (1990), 'Causal ambiguity, barriers to imitation, and sustainable competitive advantage', *The Academy of Management Review*, **15** (1), 88–102.
Ring, P.S. (1999), 'Processes facilitating reliance on trust in inter-organizational networks', in M. Ebers (ed.), *The Formation of Inter-organizational Networks*, Oxford: Oxford University Press, pp. 113–45.
Ring, P.S. and A.H. van de Ven (1994), 'Developmental processes of cooperative interorganizational relationships', *Academy of Management Review*, **19** (1), 90–118.
Romme, A.G.L. (2003), 'Making a difference: organization as design', *Organization Science*, **14** (5), 558–73.
Romme, A.G.L. and G. Endenburg (2006), 'Construction principles and design rules in the case of circular design', *Organization Science*, **17** (2), 287–300.
Simonin, B.L. (1999), 'Ambiguity and the process of knowledge transfer in strategic alliances', *Strategic Management Journal*, **20** (7), 595–623.
Singh, J. (2005), 'Collaborative networks as determinants of knowledge diffusion patterns', *Management Science*, **51** (5), 756–70.
Soekijad, M. (2005), *Dare to Share: Knowledge Sharing Professionals in Co-opetitive Networks*, Dissertation, Delft: TU Delft.
Soekijad, M. and E. Andriessen (2003), 'Conditions for knowledge sharing in competitive alliances', *European Management Journal*, **21** (5), 578–87.
Spekman, R.E., J. Spear and J. Kamauff (2002), 'Supply chain competency: learning as a key component', *Supply Chain Management*, **7** (1), 41–55.
Steensma, H.K. and K.G. Corley (2000), 'On the performance of technology-sourcing partnerships: the interaction between partner interdependence and technology attributes', *Academy of Management Journal*, **43** (6), 1045–67.
Swan, J. and H. Scarbrough (2005), 'The politics of networked innovation', *Human Relations*, **58** (7), 913–43.
van Aken, J.E. (2004), 'Management research based on the paradigm of the design sciences: The quest for field-tested and grounded technological rules', *Journal of Management Studies*, **41** (2), 219–46.
van Aken, J.E. and M.P. Weggeman (2000), 'Managing learning in informal innovation networks: overcoming the Daphne-dilemma', *R&D Management*, **30** (2), 139–49.
van Baalen, P., J. Bloemhof-Ruwaard and E. van Heck (2005), 'Knowledge sharing in an emerging network of practice: the role of a knowledge portal', *European Management Journal*, **23** (3), 300–14.
Walker, G., B. Kogut and W. Shan (1997), 'Social capital, structural holes and the formation of an industry network', *Organization Science*, **8** (2), 109–25.
Winter, S.G. (1987), 'Knowledge and competence as strategic assets', in D.J. Teece (ed.), *The Competitive Challenge*, Cambridge, MA: Ballinger.
Wynstra, F., M. Weggeman and A. van Weele (2003), 'Exploring purchasing integration in product development', *Industrial Marketing Management*, **32** (1), 69–83.

APPENDIX: LITERATURE ABOUT KNOWLEDGE SHARING IN A NETWORK

For each solution concept, we present the papers that support the application of this concept to enable knowledge sharing in a network. We also show the kind of evidence that a paper presents: case study results (C), quantitative results (i.e. surveys and patent counts) (Q), literature reviews (L) and theory development without empirical evidence (T).

Table 3.2 Literature about knowledge sharing in a network

Solution concept	**Article**
Personnel transfer	C Dyer and Nobeoka (2000), Inkpen and Dinur (1998) T Inkpen (1998), Inkpen (2000), Inkpen and Tsang (2005)
Printed and electronic media	C Gittel and Weiss (2004), Newell and Swan (2000) Q Spekman et al. (2002), van Baalen et al. (2005)
Knowledge brokers	C Dyer and Nobeoka (2000), Gittel and Weiss (2004), Inkpen and Dinur (1998), Soekijad and Andriessen (2003), Swan and Scarbrough (2005) L Grandori and Soda (1995) Q van Baalen et al. (2005) T Inkpen (2000)
Direct communication	C Carlile (2004), Daghfous (2004), Dyer and Nobeoka (2000), Gittel and Weiss (2004), Inkpen and Dinur (1998), Newell and Swan (2000), Orlikowski (2002), Soekijad and Andriessen (2003) L Ring and van de Ven (1994) Q Hansen (1999), Liebeskind et al. (1996), Spekman et al. (2002) T Inkpen (1998), Inkpen (2000), Jones et al. (1997), Ring (1999)
Goal alignment	C Knight and Pye (2004), Knight and Pye (2005), Newell and Swan (2000), Soekijad and Andriessen (2003), Swan and Scarbrough (2005) L Das and Teng (2002), Grandori and Soda (1995) Q Mowery et al. (1996), Muthusamy and White (2005), Reagans and McEvily (2003), Spekman et al. (2002) T Inkpen (1998), Inkpen (2000), Inkpen and Tsang (2005), Jones et al. (1997), Larsson et al. (1998), Ring (1999)
Interpersonal relationships	C Dubois and Håkansson (1999), Hamel (1991), Hardy et al. (2003), Lorenzoni and Lipparini (1999), Newell and Swan (2000), Orlikowski (2002), Soekijad and Andriessen (2003), Swan and Scarbrough (2005)

Table 3.2 (continued)

Solution concept	Article
	L Das and Teng (2002), Grandori and Soda (1995), Inkpen and Tsang (2005), Ring and van de Ven (1994) Q Ahuja (2000), Kale et al. (2000), Liebeskind et al. (1996), Muthusamy and White (2005), Powell et al. (1996), Reagans and McEvily (2003), Simonin (1999), Singh (2005), Steensma and Corley (2000) T Brown and Duguid (2001), Duysters et al. (1999), Ebers (1999), Inkpen (2000), Jones et al. (1997), Mody (1993), Powell et al. (1996), Ring (1999), van Aken and Weggeman (2000)
Rules and agreements	C Dyer and Nobeoka (2000), Muthusamy and White (2005), Newell and Swan (2000), Orlikowski (2002), Soekijad and Andriessen (2003), Swan and Scarbrough (2005) L Grandori and Soda (1995) Q Muthusamy and White (2005), Peña (2002), Spekman et al. (2002), Steensma and Corley (2000) T Inkpen (1998), Inkpen (2000), Inkpen and Tsang (2005), Jones et al. (1997), Larsson et al. (1998), Mody (1993), Ring (1999)
Partner selection	C Carlile (2004), Daghfous (2004), Hamel (1991), Inkpen and Dinur (1998), Knight and Pye (2004), Newell and Swan (2000), Orlikowski (2002), Soekijad and Andriessen (2003) L Grandori and Soda (1995), Podolny and Page (1998) Q Lane and Lubatkin (1997), Mowery et al. (1996), Muthusamy and White (2005), Powell et al. (1996), Reagans and McEvily (2003), Simonin (1999), Spekman et al. (2002) T Brown and Duguid (2001), Duysters et al. (1999), Grant and Baden-Fuller (2004), Inkpen (1998), Inkpen (2000), Larsson et al. (1998), Powell et al. (1996)
Absorptive capacity	C Carlile (2004), Daghfous (2004), Hamel (1991), Inkpen and Dinur (1998), Knight and Pye (2004), Knight and Pye (2005), Orlikowski (2002), Soekijad and Andriessen (2003), Swan and Scarbrough (2005) L Grandori and Soda (1995), Podolny and Page (1998) Q Lane and Lubatkin (1997), Liebeskind et al. (1996), Mowery et al. (1996), Reagans and McEvily (2003), Simonin (1999), Spekman et al. (2002) T Brown and Duguid (2001), Duysters et al. (1999), Grant and Baden-Fuller (2004), Inkpen (1998), Inkpen (2000),

Table 3.2 (continued)

Solution concept	Article
	Inkpen and Tsang (2005), Jones et al. (1997), Larsson et al. (1998), Powell et al. (1996), Ring (1999)
Trust and commitment	C Dyer and Nobeoka (2000), Knight and Pye (2005), Newell and Swan (2000), Orlikowski (2002), Soekijad and Andriessen (2003), Swan and Scarbrough (2005)
	L Das and Teng (2002), Grandori and Soda (1995), Ring and van de Ven (1994)
	Q Hansen (1999), Kale et al. (2000), Liebeskind et al. (1996), Mowery et al. (1996), Muthusamy and White (2005), Peña (2002), Powell et al. (1996), Reagans and McEvily (2003), Spekman et al. (2002), Steensma and Corley (2000)
	T Duysters et al. (1999), Inkpen (2000), Inkpen and Tsang (2005), Jones et al. (1997), Larsson et al. (1998), Mody (1993), Ring (1999)
Network identity	C Dyer and Nobeoka (2000), Orlikowski (2002), Soekijad and Andriessen (2003)
	Q Hansen (1999)